# Appendix H

# Model Parameter Tools

Introduction

This appendix describes the tools that should be provided in DDAP to derive parameter estimates for selected hydrologic models for specified Watersheds. These estimates are typically used as initial parameter values during model calibration. The breakdown of a Basin into Watersheds and zones within Watersheds could vary from one Basin analysis to another, thus a PETA must be selected prior to using the Model Parameter tools.

PETA Selection

When the Model Parameter category is chosen, the user should first be given a list of PETAs that exist for the Basin. The user will then choose the appropriate PETA. For the Model Parameter tools, the period of record (HPOR or an extension) shouldn't affect the analyses, thus there is no need to make a period of record choice.

Basic Display

Once a PETA has been selected, the basic display for the Model Parameter tools window should contain the following in addition to overlay, zoom, query, and units features:

- Basin boundaries - i.e. the overall boundaries of the Basin currently selected as specified in the Basin definition (not Watershed boundaries), and

- Watershed boundaries for all Watersheds currently defined for the Basin and PETA selected (headwater and local area boundaries should probably be in different colors).

Menus

Control and Tools menus should be included. The Control menu only needs a Quit option. The tools menu should initially contain the following options (tools might be developed for other models later):

- Synthetic Unit Hydrograph,
- Sacramento Model UHG from Storm Events, and
- Sacramento Model.

Each of the Model Parameter tools are described in this appendix starting on separate pages.

# Synthetic Unit Hydrograph

Function: To define unit hydrographs for a Watershed using various synthetic methods.

Input:

- User selection of a Watershed and drainage area to use (default drainage area should be that input to the Watershed Boundaries tool described in Appendix B),
- If Watershed has multiple zones, an indicator as to whether unit hydrographs should be derived for each zone or whether a single unit hydrograph should be determined for the entire Watershed,
- User specification of which of the available synthetic methods to use, and
- User specification of the time interval and ordinate spacing for the unit hydrograph(s).

Procedure and Displays: Methods currently included in IHABBS that are selected by the user should be used to derive synthetic unit hydrographs for the specified Watershed (see IHABBS documentation for description of methods and data sets needed - other methods could be added in the future). Each method may need user supplied coefficients or other information (defaults or choices should be provided). The resulting unit hydrographs should be plotted and the user can then choose which method to use.

Output: The resulting unit hydrograph(s) should most likely be output in the form needed by the UNIT-HG operation (see NWSRFS User's Manual Section V.3.3-UNIT-HG). How they are stored in the data base depends on how the model calibration programs (MCP, ICP, and OPT) are integrated into an enhanced calibration system.

## Sacramento Model UHG from Storm Events

Function: To attempt to derive a unit hydrograph for a Watershed from discharge and precipitation data for selected storm events.

Input:

- User selection of a Watershed and drainage area to use (default drainage area should be that input to the Watershed Boundaries tool described in Appendix B),
- Specification of discharge time series - if multiple time series available for the Watershed (e.g. instantaneous and mean daily or observed and adjusted), user specifies which to use,
- If mean daily flow is to be used, peak flow data should be included, if available (see NWSRFS User's Manual Sections V.3.3-PEAKFLOW and III.2-PEAKFLOW),
- MAP time series for the Watershed - if multiple zones, the fraction of the area in each zone is also needed, and
- User specification of the time interval and ordinate spacing for the unit hydrograph.

Method and Displays: This tool should provide interactive, graphic capabilities to apply the procedure described in Section 7-6 of the Calibration Manual under the heading Derivation of a Sacramento Model Unit Hydrograph from Storm Events. The resulting unit hydrograph would apply to the entire Watershed. The user should be able to scan the specified hydrograph and MAP values on a plot to select possible events. The user would then be able to interactively separate the fast response runoff from other components (base flow withdrawal rates and runoff amounts would need to be provided). A unit hydrograph could then be derived by interactively applying the 'S' curve method with various assumed runoff durations for the storm event. Unit hydrographs should be able to be derived from multiple events and then compared. The user can then choose one of the resulting unit hydrographs or draw an average unit hydrograph (sum of ordinates automatically adjusted to the correct drainage area).

Output: The resulting unit hydrograph should most likely be output in the form needed by the UNIT-HG operation (see NWSRFS User's Manual Section V.3.3-UNIT-HG). How it is stored in the data base depends on how the model calibration programs (ICP/MCP, and OPT) are integrated into an enhanced calibration system.

# Sacramento Model

Function: To derive parameter values for the Sacramento Soil Moisture Accounting Model from soils and vegetation data and/or hydrograph analysis..

Parameters and Options: There are a total of 17 parameters needed by the Sacramento Model (UZTWM, UZFWM, UZK, PCTIM, ADIMP, RIVA, EFC, ZPERC, REXP, LZTWM, LZFSM, LZFPM, LZSK, LZPK, PFREE, RSERV, and SIDE). Of these 13 or 14 can be assigned values with this tool. The RSERV parameter should always be defaulted to 0.3 and the RIVA and SIDE parameters should be defaulted to 0.0. If snow is not to be included for the Watershed, EFC can be set to 0.0. Values for the remaining parameters can be derived or specified by the user via this tool. Mean monthly values of ET Demand or the seasonal variation in PE adjustments that are required for the Sacramento Model are to be obtained from the Estimate Areal ET Demand or Seasonal PE Adjustment Curve tools described in Appendix G.

This tool should contain 3 basic options. These are:

- Hydrograph Analysis,
- Soils Data, and
- Combined Soils and Hydrograph Analysis.

In each case the EFC parameter, if needed, should be determined from vegetation information.

Input:

- User selection of a Watershed - if multiple zones exist, parameters are derived for all zones,
- Indicator as to which option is to be used,
- If Hydrograph Analysis included, specification of mean daily discharge time series to be used from those available for the Watershed,
- If Hydrograph Analysis included, MAP time series must be available - if multiple zones, the fraction of the Watershed within each zone is needed,
- If Hydrograph Analysis included, the period of record to be used (default to the period when both mean daily flow and MAP data are available),
- If Soils included, a gridded data set of parameter values derived from soils information that covers the Basin (at least this is the approach currently used in CAP, i.e. the values are determined once for the entire country or RFC area from the necessary soils information and stored in a gridded form), and
- Indicator as to whether snow is to be modeled for this Watershed (default to 'on' if MAT time series exist, otherwise default to 'off').

Method: The method used depends on the option selected. Each will be described separately.

**Effective Forest Cover (EFC)**

This parameter is derived the same way no matter which option is chosen. The value of

EFC should ideally be the fraction of the area covered by conifer vegetation multiplied by the average conifer cover density. It may not be possible to derive this quantity directly from the available vegetation related data sets. If not, the fraction of each area cover by conifer vegetation should be estimated and other relevant information regarding the type of conifers presented to aid the user in subjectively estimating the cover density.

**Soils Data**

This option should use the method devised by Koren (Koren et. al., 2000, Use of Soil Property Data in the Derivation of Conceptual Rainfall-Runoff Model Parameters) to determine estimates for 11 of the Sacramento model parameters (or any procedure that supersedes this method). The parameters that are obtained with the Koren procedure are: UZTWM, UZFWM, UZK, ZPERC, REXP, LZTWM, LZFSM, LZFPM, LZSK, LZPK, and PFREE. Values for these parameters would be obtained for each zone within the Watershed by integrating the gridded soil based estimates of these parameters over the drainage area assigned to each zone. Values for the PCTIM and ADIMP parameters would be specified by the user.

**Hydrograph Analysis**

Interactive capabilities would be provided for the user to derive estimates of 13 Sacramento Model parameters using the techniques described in Section 7-5 of the Calibration Manual. These techniques would involve the use mean daily flow and MAP time series. For some parameters the user would be asked to choose an appropriate period and possibly make other selections prior to the parameter estimate being computed. For other parameters, guidelines would be provided and the user would make a selection after examining the hydrograph response under various situations.

**Combined Soils and Hydrograph Analysis**

One of the main weaknesses of the soils based method of estimating Sacramento Model parameter values is the determination of lower zone free water storages and withdrawal rates, i.e. parameters LZFSM, LZFPM, LZSK, and LZPK. These are also some of the parameters for which good estimates can normally be obtained from a hydrograph analysis. Thus, another approach would be to allow the user to interactively determine the values for these 4 parameters based on mean daily flow and MAP data, and then estimate the other parameters using the Soils Data procedure.

Output: The resulting Sacramento Model parameter values should most likely be output in the form specified for cards 3 and 4 of the SAC-SMA operation (see NWSRFS User's Manual Section V.3.3-SAC-SMA - PXADJ and PEADJ set to 1.0). How they are stored in the data base depends on how the model calibration programs (ICP/MCP, and OPT) are integrated into an enhanced calibration system.